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THE ACTINOMYCES-LIKE GRANULES IN TONSILS.*

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In the crypts of tonsils one commonly finds masses of gray or yellow material, foul-smelling, and varying considerably in appearance. These masses are referred to as tonsillar plugs (*Pfröpfe*) and are usually said to consist of bacteria, epithelial débris, etc. If one examines them carefully it is seen that they are not all alike. Some are made up of small grayish masses or clumps of desquamated and often hyalinized epithelial cells, in which a few cocci and bacilli without any definite arrangement may be found. Others are composed of soft, yellowish, pasty or waxy material and occur in occluded or partially occluded crypts. Cholesterin crystals are commonly found in them, but bacteria are rare and often not present. At times small cysts appear. There may also be formed real abscesses, containing thick pus, which in their early stages yield on culture various bacteria, but later are often sterile.

A third variety of tonsillar masses differs decidedly from the masses mentioned above and it is these that I wish to discuss in this paper. They are small, definite, grayish bodies or granules, rather brittle in consistency, and reveal, on examination, a raylike structure resembling in some respects the granules of actinomyces. They have not been the subject of much interest nor have investigations in regard to their real nature been numerous. In most textbooks they are not even mentioned. In special articles they are usually referred to as mycelial masses or growths and they have been repeatedly mistaken for actinomyces, a point which I shall discuss later. Here I wish merely to state that while their raylike structure bears a very superficial resemblance to the granules of actinomyces, in reality they are entirely different and indeed are not even remotely related biologically to the actinomyces group.

The first mention of these bodies in the literature appears to be a statement by Johne[1] in 1881 who called attention to certain granules resembling actinomyces found

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[1] Quoted by Bostroem, *Beiträge z. path. Anat. u. z. allg. Path.*, 1891, 9, p. 1.

in the tonsils of swine. A detailed description of them is not given but he states that they are similar to actinomyces granules and perhaps identical. Bostroem[1] states that he was able to confirm Johne's work, but he likewise does not describe them in detail, saying simply that morphologically they correspond to actinomyces.

Ruge[2] seems to be the first to call attention to these bodies in human tonsils. He says that it is probable that they belong to the actinomyces group, but he maintains that they are not identical with actinomyces hominis. They differ from the latter in having larger granules and coarser filaments and the granules are firmer and more durable. Club-bearing ends were not found. He points out that these bodies are not stained by Gram stain, while real actinomyces granules are so stained. Cultivation was evidently not attempted. He considers it possible that they may have something to do with hypertrophy of the tonsils.

Jonathan Wright[3] describes a case in which he found raylike granules in a sectioned tonsil. He refers to Ruge's paper as the only one that he could find in the literature on actinomycosis of the tonsils. In a footnote he says, however, that he is unable to conjecture whether Ruge's cases were actinomycosis or not. He notes that Ruge referred to the granules as "actinomyces-like," but he himself does not appear to consider the possibility that these bodies, which he also found in the tonsillar crypts, might not be true actinomyces. He describes their raylike structure and fortunately gives some drawings. To anyone familiar with these bodies it is clearly evident from his Figs. 1 and 4 that he is not dealing with true actinomyces but with the mycelial masses resembling actinomyces. He speaks of the proliferation of epithelium lining those crypts which contain the granules. No attempt to cultivate the organisms was made nor did he study them in smear preparations.

Gappisch[4] reviews the previous work done on this subject and gives a good description supplemented with photographs of these growths. The raylike structure and brushlike ends at the margin of the granules are well shown as are also the masses of bacilli and cocci. No reference is made to the spirilla forms. He states definitely that these granules are not actinomyces and indeed he appears to be the first to make this unequivocal statement concerning these bodies. Evidently no attempt was made to grow the various organisms. A point of interest in this work is the statement that the structures may invade the tissues. In two of his cases (Cases 1 and 10) there is loss of crypt epithelium and the masses lie in abscess cavities in the follicles where, he says, they remind one of actinomyces abscesses.

In 1906 Miodowski[5] pointed out that these granules have nothing to do with true actinomyces. In 147 cases he found them 12 times. At autopsy in 9 cases he found them once and in 19 operative cases he found them 4 times. He makes the statement that they are slightly gram-positive, differing, in this respect, from Ruge's results. He says that this condition is in no way related to the pharyngomycosis of *B. Fränkel*. He would not deny that they might have something to do with hypertrophy but thinks that in hyperplastic tonsils the conditions of the crypts are favorable for the development of these masses. He never found them in the pharyngeal tonsil tissue tho he examined as many of these as of faucial tonsils. He gives some excellent colored plates, an examination of which convinces one that he is surely dealing with these actinomyces-like masses and not with true actinomyces.

[1] *Loc. cit.*

[2] *Ztschr. f. klin. Med.*, 1896, 30, p. 529.

[3] *Am. Jour. Med. Sc.*, 1904, 128, p. 74.

[4] *Verhandl. d. deutsch. path. Gesellsch.*, 1905, 9, p. 130.

[5] *Arch. f. Laryngol. u. Rhinol.*, 1906, 19, p. 277.

From this review of the literature it appears that only a few of the essential features of the morphology of these bodies have been described and that no attempt has been made to cultivate and isolate them and to study their pathogenic properties. It is also evident that they have been confused with true actinomyces by several writers, a confusion which at present should not exist.

MORPHOLOGY OF GRANULES.

The granules are found only in the crypts and are usually small grayish or grayish-yellow bodies whose size is variable. They are commonly about as large as a pinhead but they may be much larger or much smaller. Occasionally they attain the size of a split pea and are with difficulty forced from the crypt openings. On the other hand, they are often so small as to be visible only with a lens or microscope. In shape they are irregular, being often lobulated. They are quite brittle, readily breaking into smaller fragments which later may be difficult completely to disintegrate. Calcification may be present in the mass, thus forming the tonsil stones. They invariably have a foul and disagreeable odor, especially when crushed, an odor which corresponds very well with that so often detected on the breath of persons having diseased tonsils. These bodies are found usually near the outlet and in the more expanded portions of the larger crypts; they may occur, however, deep down near the base of the crypts. As to their frequency, I think it is probably true that every tonsil contains these bodies at times. They are discharged from the crypts from time to time and on removal of the tonsils they are readily forced out of the crypts. In order to give some idea of their frequency I may state that in a careful examination of 122 pairs of tonsils, chiefly from children, they were visible to the naked eye or readily

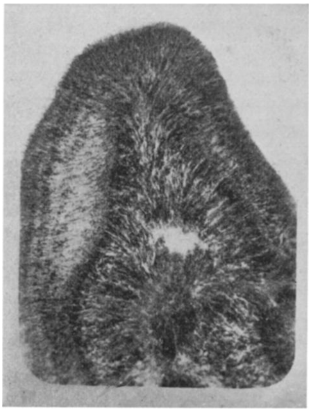

FIG. 1.—Section of actinomyces-like granule lying in a tonsil crypt. About one-half of the entire granule is shown. Hematoxylin and eosin stain. ×120.

seen with a hand lens in the crypts of 30 tonsils. When found they were usually present in both tonsils tho there were many exceptions. These were all extirpated tonsils and no doubt in their enucleation in some instances these bodies were forced out from the crypts and lost. Furthermore, in microscopic preparations one sees frequently in the crypts very small raylike granules which would not be visible by an examination such as was made in the above-mentioned series. There is no doubt, therefore, that these granules are considerably more frequent in tonsils than the foregoing data indicate.

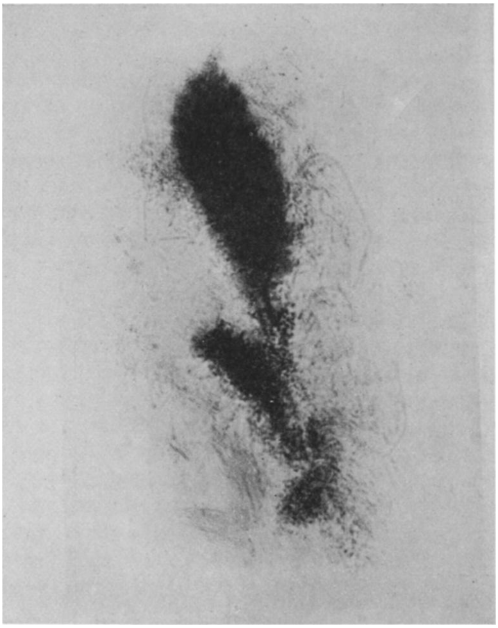

FIG. 2.—The brush-like ends which occur at the margin of the granules. The fusiform bacilli are arranged perpendicular to a central stalk. ×1000.

Microscopically they present a very characteristic raylike structure. Fig. 1 is a photograph made from a section through such a granule lying in a tonsil crypt. The raylike structure is especially conspicuous. Near the center the mycelial filaments run in various directions tho generally outward. Nearer the periphery they assume a more parallel arrangement, the transition zone being distinctly noticeable in the figure. In the centers of the granules it is not uncommon to see lime deposits, vegetable particles, etc., and often here and there large crystals which are probably fatty acid in nature. The structure of these bodies can be readily brought out by placing them on a glass slide in a drop of methylene blue or dilute carbolfuchsin and then pressing down a cover glass gently in order to spread the mass. At the periphery with the low power, club-like structures appear, which with higher magnification are shown to have a somewhat complicated morphology. Such a structure is shown in Fig. 2. It consists essentially of a central shaft composed of mycelial filaments about which are arranged myriads of elongated bodies or bacilli vertical to the shaft. It may be compared to an ordinary test tube brush, the bristles of the brush corresponding to the bacilli and the wire shaft corresponding to the central filaments. The elongated bodies attached to the shaft are very easily detached by slight manipulation, as for example by making smear preparations, and then one

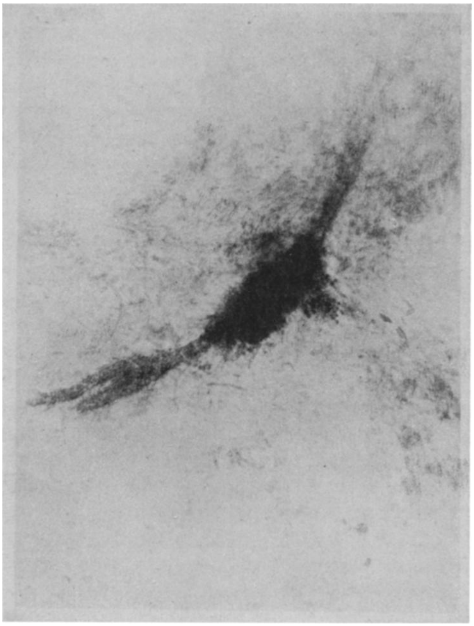

FIG. 3.—A branching stalk from which most of the fusiform bacilli have been separated. ×1000.

sees the stalks with few or almost no bodies attached. In Fig. 3 is shown a branched stalk from which the bodies have been separated except at a point farther down where some are still attached. The central stalk, it should be pointed out, is composed of one or commonly a bundle of filaments. The apparent branching is not a true branching of the filaments but simply a separation or division of the bundle. I have never seen true branching of the filaments or of the bacilli.

When the granules are carefully washed through several changes of sterile salt solution and smears are made therefrom by crushing, four kinds of organisms are always seen: namely, cocci, spirilla bacilli, and filaments.

The cocci belong to the streptococcus group. In smear preparations they occur at times singly, usually in pairs, rarely in short chains. They are strongly gram-positive. As a rule they grow rather feebly in aerobic cultures and somewhat better under anaerobic or partial anaerobic conditions. Some strains produce green color on blood agar, but as a rule they hemolyze slightly and often form a rather hazy zone about the colony. At times the zone may be clear and quite like that produced by the ordinary hemolytic streptococcus. These cocci when injected intravenously into rabbits may produce arthritis, but they possess, in general, low virulence and cause lesions only when given in large doses.

The spirilla are rather long and coarse (Figs. 4 and 5). They are gram-negative and stain readily tho faintly with ordinary dyes. Carbolfuchsin is a very satisfactory stain for them. They are always found in the smears, at times in enormous numbers. As yet no attempt has been made to study their cultural features.

In smear preparations of the granules the bacilli are seen mostly detached from the stalklike filaments, tho here and there if the smear has been carefully made there may be considerable numbers of them still adherent (Figs. 3 and 4). Usually they have pointed ends and stain unevenly; some show a definite barred appearance. Most of them are slightly curved. They stain readily with ordinary dyes and are weakly gram-positive. Too long washing in alcohol will decolorize them completely. Undoubtedly some workers would call them gram-negative. It may be said that they have the morphology and staining properties of *B. fusiformis*. The filaments comprising the mycelial mass readily break up into longer or shorter threads. These are never branched and they do not contain septa. Often distinct granules are seen within the filament. They stain readily especially with carbolfuchsin and react to Gram stain in a manner similar to the bacilli above described. The relation of the filaments to the bacilli will be discussed later.

The cultivation of these bacilli is a matter of some interest, since, so far as the literature indicates, they have never been grown artificially. The following method was used successfully. The granule is thoroughly washed through several changes of sterile salt solution in order to get rid, as far as possible, of surface contamination with mouth organisms. They are then crushed in a small amount of sterile fluid from which inoculation of suitable media is made. For this purpose 2 per cent glucose agar slants plus one-third volume of blood or serum are used. Several tubes are inoculated with varying dilutions and the oxygen is then removed by an alkalin pyrogallic mixture absorbed in a cotton plug at the top of the sealed tube. Cocci are always obtained and the colonies of bacilli must be differentiated—usually by their appearance and their slow growth. The strains vary in their ability to grow on artificial media. They are all strict anaerobes. At times no growth whatever appears; again good growth may appear on the first tubes and transplants fail absolutely. When the organisms have once passed through a few subcultures they then grow readily.

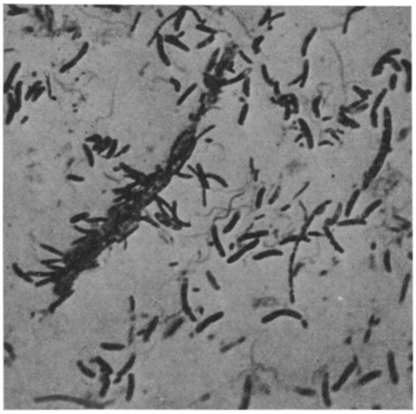

FIG. 4.—Smear preparation of a granule showing fusiform bacilli, spirilla, and cocci. The fusiform bacilli predominate. A stalk is also shown to which a few fusiform bacilli are still attached. ×1200.

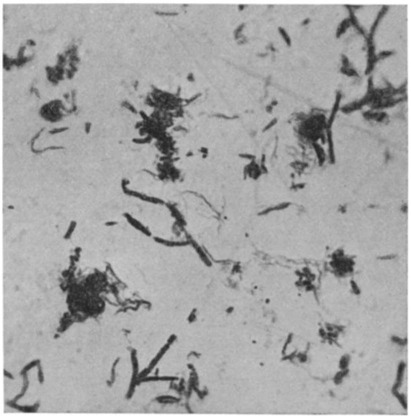

FIG. 5.—Smear preparation of granule showing large numbers of spirilla forms. Also some fusiform bacilli and cocci. ×1200.

Of late I have used with success the method described by Krumwiede and Pratt,[1] which consists of a serum-sugar agar-plate culture the cover of which is imposed directly on the media in the plate in an inverted position. Thus there is a thin layer of media between the two glass surfaces. After 48 or 72 hours the plates are torn apart and the colonies then may be transferred to tube cultures.

For carrying along the cultures, serum or blood glucose agar slants or stabs are suitable. Serum gelatin agar is also suitable, tho it possesses no advantage over the serum glucose agar.

The colonies are barely visible on plates in 24 hours; after 48 hours they appear as small grayish colonies with somewhat irregular margins. They never become large and cease growing in size after about four or five days. On serum media they are gray; on blood media the color is dark brown or even reddish. On slants the growth when diffuse has a rough stippled appearance which does not penetrate below the surface. It is readily removed from the surface and forms without difficulty a fairly homogeneous suspension in fluid. On blood agar slant tubes the colonies will often grow in abundance between the glass and the media. Here they become quite large and may occur entirely around the tube and about the bottom, presenting a rather characteristic appearance against the dark-red background of media. In sterile tissue placed in the bottom of test tubes and covered with media pure cultures of the bacilli readily grow; they penetrate the tissues, causing a rapid disintegration with a fairly characteristic odor. No gas is produced in glucose media. They do not grow in plain broth, litmus milk, or on potato.

It may be stated that these organisms never form colonies or granules on artificial media that in any way resemble the granules in the tonsils. If these granules are carefully planted in sterile animal tissue placed at the bottom of a tube and covered with media there is evidence of increase in size of the granule but it is never marked. Immediately about the granule the long bacilli mixed with cocci may be found in large numbers. Under these conditions a very disagreeable odor is formed and the tissue becomes putrid. Here, also, it is to be noted that the spirilla forms also appear in large numbers and undoubtedly multiply under these conditions tho they have not yet been isolated pure. The odor when the entire granule is inoculated is much more intense and indeed is somewhat different in character from that produced by a pure culture of the bacillus or by the bacillus and the coccus together. The difference is therefore probably due to the presence of the spirilla forms.

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[1] *Jour. Infect. Dis.*, 1913, 12, p. 199.

In morphology the strains of bacilli when growing in pure cultures vary considerably. Fig. 7 is a photograph of a pure growth which has passed through many generations. The bacilli stain readily with carbolfuchsin, less readily with Löffler's methylene blue. Giemsa is a satisfactory stain as is also polychrome methylene blue.

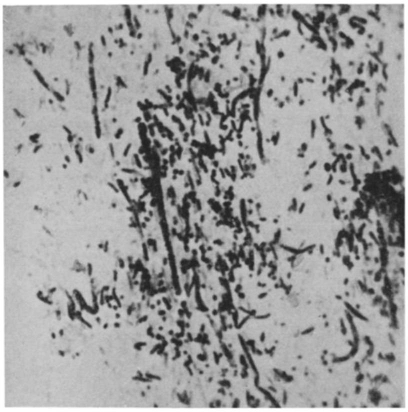

FIG. 6.—Smear preparation of a granule stained by Gram. The cocci stain clearly. The fusiform bacilli stain unevenly, some quite distinctly, others very poorly. Spirilla forms are not stained. ×1200.

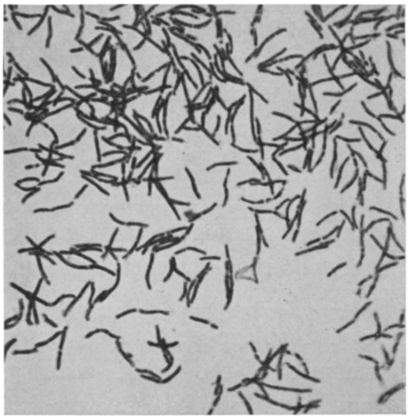

FIG. 7.—Pure culture of fusiform bacilli from actinomyces-like granule grown under anaerobic conditions on blood glucose agar. ×1200.

They are weakly gram-positive and are non-motile. Some strains have a very decided fusiform shape with pointed ends while other strains are more threadlike or filamentous in form. Often the bacilli are arranged end to end, forming at times long chains, which, however, are readily broken up into their elements. Branching never occurs. Granules within the bacilli are at times clearly visible and are best stained with methylene blue.

The relation of the bacilli and filaments is a matter which I have given careful consideration. At first I thought that they were different organisms in view of their very different morphology.

However, I am now inclined to believe that they are only different forms of the fusiform bacillus. The organisms of this type as they are obtained in cultures vary strikingly in their morphology, some being short and fusiform, others longer and more threadlike. In other respects, however, they are quite alike. They are all strictly anaerobes, their growth on media is identical and their reaction to Gram stain is alike both in the artificial cultures and also in smears made directly from the tonsil granules. I think one is therefore justified in considering the bacilli and the filaments different forms of the same organism. I do not consider this point absolutely proven, however, because one might assume that the filaments in the granules are different organisms, which do not grow in the anaerobic cultures, and that the thread forms which one does obtain in the cultures are forms of the fusiform bacilli seen in the granules.

PATHOGENICITY.

The pathogenic properties of the granule and also of the cocci and the fusiform bacilli have been studied.

A small granule was carefully washed, macerated in a suspension of salt solution, and injected into the peritoneal cavity of a half-grown rabbit. Eight days later the animal died and examination revealed this rather remarkable condition of the peritoneum. Large abscesses 1 cm. or more in diameter occurred in the mesentery and about the intestines which were more or less matted together. They were found about the spleen and also here and there adherent to the parietal peritoneum. The organs themselves were not involved and the thoracic cavity had not been invaded. The heart's blood was sterile. The abscesses had well defined connective tissue walls and the centers were soft and contained thick pus which had a foul odor. Smears of this pus made from several of the lesions always showed gram-positive diplococci and bacilli fusiform or filamentous in character. In only one smear were a few spirilla seen. The cocci and bacilli were successfully cultivated from these lesions and corresponded with the organisms found in the granules. In sections of the abscesses dense, deeply staining masses were common which on careful examination were found to consist of clusters of bacilli. With low magnification they simulated actinomyces granules. They were not the original masses injected, for these had been thoroughly macerated in a mortar. Evidently then in the tissues these bacilli grow in clusters which, however, are not as dense nor as definitely raylike as are the original tonsil granules.

A second small rabbit about six weeks old was similarly inoculated. This animal lived 21 days and became emaciated before death. Lesions similar to those found in the first animal appeared in the peritoneum. Several small nodules containing pus developed on the abdominal wall near the point of injection and the bacteriologic examination showed the presence of cocci and fusiform bacilli as in the first instance. Several full-grown rabbits were inoculated with tonsil granules without success.

A small white rat was inoculated intraperitoneally with one of the macerated granules and died five months later. Before death it became emaciated. In the peritoneal cavity surrounded by fibrous adhesions was a large encapsulated, necrotic mass which measured 5×3 cm. and contained dirty, gray, foul-smelling pus. Smears of pus revealed cocci and threadlike bacilli but unfortunately cultures were not made. Large guinea-pigs are not susceptible, at least to the moderate-sized doses used in the above animals. Young pigs have not been tested.

The cocci, when injected in pure culture into young rabbits intraperitoneally in doses of one or two slant agar growths, will also produce abscesses similar in character to these described, but not so extensive and not as foul or putrid. When injected intravenously they may, as already stated, localize in joints causing multiple arthritis like ordinary hemolytic streptococci.

Pure cultures of the bacilli in large doses have been injected into young rabbits, rats, and guinea-pigs intravenously, intraperitoneally, and subcutaneously. In no instance have the inoculations caused lesions of any kind. By themselves, therefore, these bacilli seem to be non-pathogenic. However, when associated with cocci as in the granules or when injected in pure culture along with a pure culture of cocci, they appear to be able to grow and at least modify and perhaps intensify the pathogenic effects of the cocci.

In view of the fact that these tonsil granules have been confused by some with true actinomyces I have thought it worth while to discuss this phase of the subject somewhat in detail. First it may be well to compare the tonsil granules with actinomyces granules. The tonsil granules average larger than actinomyces granules, at times growing very much larger than the latter ever become. They are more easily decolorized by Gram stain. They have a characteristic foul odor which actinomyces never have. Branching forms do not occur and the filaments are as a rule coarser than actinomyces. The filaments are strict anaerobes; actinomyces are aerobes or facultative anaerobes. Club-shaped ends so characteristic of actinomyces do not occur. The structures mistaken by some for clubs are the brushlike forms already described. Finally when smear preparations are made, cocci, spirilla forms, and the bacilli are always found, whereas, in true actinomyces, only the typical branching filaments appear.

The recognition of the nature of these granules in the tonsillar crypts seems to make necessary a careful revision of all that has been written on actinomycosis of the tonsils. The literature is therefore briefly summarized here.

The works of Ruge, Johne, and Jonathan Wright already referred to can be disposed of by stating that they were all certainly dealing with these mycelial granules and not with true actinomyces. In Bostroem's series[1] of 12 there are no definitely proven cases of actinomycosis of the tonsils. In only one case (Case 5) is there even a possibility of the tonsil being the atrium. He thinks the infection here probably entered through the pharynx in the immediate neighborhood of the tonsils, since the latter showed no evidence of injury. In most of his cases of actinomycosis of the lower jaw he believes that the organisms entered the tissues by means of grains through the floor of the mouth.

Thevenot,[2] under the title of "Actinomycosis of the Tonsils," reports a patient who had an attack of acute tonsillitis and who some time later developed actinomycosis on the same side of the neck. He gives no evidence, however, that makes one believe that there was any connection between the tonsillitis and the actinomycosis. No bacteriological examination of the tonsils is reported. The teeth were very bad. He refers to another case in which there was actinomycosis of the ear and near the periphery of the tonsil in the pharyngeal wall was a fistulous tract. Sections through the tonsils, however, revealed no actinomycotic lesions.

As illustrating the necessity of discussing the relation of these granules to actinomyces I would call attention to the work on actinomycosis by M. Schlegel.[3] In connection with the subject of actinomycosis of the tonsils he mentions only Ruge's findings, stating that this author found these actinomyces-like forms in the crypts. Schlegel evidently has not at all appreciated the very fundamental difference between these bodies and true actinomyces.

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[1] *Beitr. z. path. Anat. u. z. allg. Path.*, 1891, 9, p. 1.

[2] *Lancette française Gazette d. hop.*, Paris, 1904, 77, p. 1070.

[3] Kolle u. Wassermann, *Handbuch d. Path. Mikroorg.*, 1912, 5, p. 329.

The above reports are all that I can find in the literature bearing on this subject. It appears that the idea is prevalent that actinomyces may enter the tissues about the neck from the tonsils but the evidence for this is not at all convincing. One difficulty in determining this point is due to the fact that the original atrium of infection is not easy to find because actinomycotic processes are slow and healing often occurs rapidly. I think there is no doubt that in some instances the infection has gained entrance somewhere in this neighborhood. Possibly it may enter at times through the tonsillar crypts but from the cases reported it does not appear that this point has yet been proven.

It should be stated that it is possible, of course, for true actinomyces to occur in tonsils in association with these raylike granules. I have carefully searched my preparations of these latter for gram-positive branching filaments typical of actinomyces but have not succeeded in finding them. In this connection I should like to refer to the work of F. T. Lord,[1] who found in smears from tonsil crypts organisms resembling actinomyces and he also observed actinomycotic abscesses in the omentum of guinea-pigs after intraperitoneal injection of the contents of tonsillar crypts. He does not carefully describe the material that he injected but merely states that it consisted of masses from the tonsils. I think there is little doubt that these granules were included. The lesions obtained by me in the omentum of rabbits contain masses of bacilli very similar to those in the omental abscesses described by Lord. However, I have never seen any structures resembling clubs in these experimental abscesses and Lord definitely describes these structures in his preparations. If these structures he describes are true actinomyces it probably means, of course, that these tonsil granules and true actinomyces may occur in the tonsillar crypts together. Without attempting to settle this point here, I will only say that, experimentally, definite abscesses can readily be produced by intraperitoneal injection of the tonsil granules and that in these abscesses structures simulating true actinomyces appear. These structures, however, are only masses of mycelium from the tonsil granules and have nothing whatever to do with actinomyces.

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[1] *Jour. Am. Med. Assn.*, 1910, 55, p. 1261.

This fact must be considered in attempting to demonstrate the presence of true actinomyces in the tonsils (and also about the teeth).

Are these granules ever pathogenic for man? An answer to this question requires the discussion of a number of points. In the examination of tonsils in my own series I have never seen these mycelial masses invading the tissues. At times one sees them apparently beneath the epithelium but this is, I think, only because they have been forced there by mechanical laceration of the tonsil in its removal, the arrangement of the tonsillar tissue thereby becoming altered or distorted. It is true that others have described an invasion of the tonsillar tissue. Gappisch[1] observed this in two cases in which he states the organisms caused tissue reactions which reminded one of true actinomycosis. Wright[2] also refers to an invasion of the follicles of the tonsil by a mass of mycelium. I am not convinced that these apparent invasions were not artefacts and I believe that further data are necessary in order to establish or disprove this point.

The statement made by Wright that a marked and abnormal epithelial proliferation occurs in the tonsillar crypts about these bodies is very doubtful to say the least. I have not observed alterations of the epithelium which might not occur in a crypt with or without these granules. The granules do occur commonly in large and spacious crypts in which normally the epithelium is abundant; but this condition of the epithelium exists in all large crypts whether containing granules or not. In several tonsils I have found crypts filled with masses of these granules as large as a small pea, which have become occluded. The epithelial lining of such cavities is gray and on section the epithelial layers appear compact and more hyalinized than they do in ordinary crypts. This is due probably to pressure. I have not noted any characteristic reaction in the subepithelial tissues about such bodies that is in any way different from the plasma cell infiltration which occurs in practically all tonsils just beneath the crypt epithelium.

These bodies grow in the tonsillar crypts and from time to time are discharged. Not infrequently they become so large that there is difficulty in their discharge from the crypt openings where they may lie partly protruding perhaps for days. Under these conditions, as I know from my own experience, the adjacent tonsillar tissue may become irritated, slightly tender, and edematous. I do not know that this is anything more than the result of mechanical irritation but it may be due to both a mechanical and an infectious process.

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[1] *Loc. cit.*

[2] *Loc. cit.*

The recognition that these bodies contain enormous numbers of fusiform bacilli and spirilla brings them into possible relation with fusiform infections of the tonsils, throat, and mouth, such as Vincent's angina, noma, etc. We know that these organisms are always present about the teeth and gums, especially in dirty mouths, but here in the crypts even in carefully cleaned mouths we find them often in enormous masses hidden away in a place inaccessible to ordinary cleansing.

SUMMARY.

Actinomyces-like granules are commonly found in the crypts of tonsils. They are in no way related to true actinomyces.

These granules consist of bacilli, streptococci, and spirilla. The bacilli belong to the fusiform bacillus group and have been successfully cultivated. They are strict anaerobes. They are not pathogenic for animals.

The entire granule when injected into rabbits and rats readily produces abscesses.

A symbiotic relationship probably exists between the cocci, spirilla, and bacilli.

It is very doubtful whether these granules cause hyperplasia of the epithelium of the crypts. They occur at times in cystlike spaces in the tonsil lined by compact squamous and hyalinized epithelium.

In the literature these granules have been confused with true actinomyces; misleading statements appear especially in connection with the subject of actinomycosis of the tonsils.

There does not appear to be a well authenticated case of primary actinomycosis of the tonsil yet reported.